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ABSTRACT

Research on selective attention in learning disabled (LD) children is reviewed, and a study comparing the selective attention performance of 60 7-and 12-year-old LD and normal children to visual and auditory stimuli is reported. Each S was tested for focal and incidental memory individually in either the auditory or visual mode of stimulus presentation. All Ss were administered the Matching Familiar Figures (MFF) test of reflection-impulsivity. LD Ss were also administered two subtests of the Illinois Test of Psycholinguistic Ability (visual and auditory sequential memory). Results supported other studies which indicated no difference between LD and normal Ss on selective attention as measured by recall of focal and incidental stimuli. LD Ss, however, did not become more attentive with age to visual stimuli, as both LD and normal Ss did with auditory stimuli. Normal and LD Ss differed on the MFF error but not on MFF latency measure, calling into question the construct validity of the MFF latency score. No clear relationship was found between selective attention and reflection-impulsivity as measured by the MFF. (CL)

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FOCAL AND INCIDENTAL LEARNING OF VISUALLY AND AUDITORILY PRESENTED MATERIAL IN LEARNING DISABLED AND NORMAL CHILDREN AT TWO AGE LEVELS

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A basic psychological process in which learning disabled children have been observed to have difficulties is selective attention (Myers & Hammill, 1976). Selective attention refers to the act of selecting and processing the important information and ignoring the unimportant information from the vast amount of input that is available to the child at any given time. Cruickshank (1968) construed the distractibility observed in many learning disabled children to be an inability to inhibit attention to incidental, or unessential, stimuli. He described distractibility as "the lack of that cortical content which permits prolonged attention to the task and negative adaptation to the unessential" (1968, Pp. 4, 5).

Broadbent's (1958) general theory of information processing provides an explanation of the attentional process. Broadbent's theory describes the nervous system as a single communication channel with a limited capacity. Because of this limited capacity, one chain of events may physically exclude another. Thus, individuals must learn to deal effectively with the constant problem of multiple stimulation. This problem is handled by a "filter" mechanism for making economical use of the limited capacity of the perceptual system. These "filters" operate to separate relevant from irrelevant information. Selective mechanisms encode information on the basis of some fairly gross characteristics. Further processing then occurs only for the set-relevant materials. It is reasonable to assume that the channel capacity of every organism is limited, but some are better able to utilize the capacity through the use of more efficient "filters" or strategies.

Neisser's (1967) two-stage attention model is consistent with Broadbent's theory. He stated that stage one is a pre-attentive stage in which information

is dealt with in a global, undifferentiated way, while stage two involves an active analysis and organization of information. Stage two development implies that strategies have been developed for selecting the pertinent information to be processed.

Hagen (1972) has placed Neisser's (1967) notions into a developmental perspective. He suggested that the child comes to know that certain materials are supposed to be remembered while others are superfluous. Therefore, the child acquires a repertoire of task-appropriate strategies. One of these strategies is an inhibition of attention to extraneous or incidental information because such stimuli interfere with the encoding and storing of central or focal information.

In work with handicapped children, ideas similar to those of Broadbent (1958) and Neisser (1967) concerning selective attention have been advanced. Actually, Hewett's (1968) model of a hierarchy of sequential learning abilities, which indicates that the first and most critical ability is the ability to attend to task, is in basic agreement with the other theorists. Also relevant is the work of Zeaman and House (1959) with the mentally retarded. They have shown that attention to the appropriate cues is a critical prerequisite to learning. In fact, they have also shown that after mentally retarded children are taught to attend to the appropriate stimulus, their learning rate increases to near that of normal children.

Hagen and his associates (Drucker & Hagen, 1969; Hagen, 1967; Hagen & Sabo, 1967; Maccoby & Hagen, 1965) have carried out extensive research on the development of selective attention in normal children. The age groups they studied were usually grade 1, age 6-7; grade 3, age 8-9; grade 5, age 10-11; and grade 7, age 12-13, though younger and older subjects were used in variations of the basic procedure. They used memory for focal

and incidental stimuli as measures of selective attention, with the notion that greater recall of focal stimuli, in relation to the recall of incidental stimuli, would indicate efficiency of attention. In the Hagen studies some variation of the following procedure was used: children were presented cards containing two pictures. The pictures were divided into two conceptual categories, usually animals and houschold objects. An instance of each of the two categories appeared on each card. The cards were arranged in a series varying in length from four to six cards. Children were tested individually. For half the children, the animal was the focal stimulus; for the other half, the household object was the focal stimulus. The picture on the card which was not the focal stimulus was the incidental stimulus. Each child was instructed to remember the position of each card containing the focal stimulus (e.g., the animal). The incidental stimulus (e.g., household object) was not mentioned in the instructions to the children. Twelve trials were given, and the focal learning score was the number correct in the 12 trials. After the focal procedure was completed, incidental recall was measured. For this measure a picture of the focal stimulus only was placed in the same position it had occupied on the test cards. The incidental stimuli were prepared as individual cutouts and placed in front of the child. His task was to match the animals with the household objects with which they had always appeared. The measure of incidental memory was the number matched correctly. Thus, although the children were instructed to remember the focal stimuli, they were later tested not only on recall of the focal stimuli, but also on recall of the incidental stimuli.

Findings have been consistent in indicating that focal memory performance increased with age while incidental memory performance did not change.

These findings have been interpreted to mean that, with increasing age, children develop improved ability to selectively attend to and process focal, and to ignore incidental, information. Also, correlations between the two response measures were negative at the oldest age levels, indicating that those who performed well on focal recall ignored incidental information. This finding suggested that the ability to maintain task performance by excluding incidental information improves with age.

Stevenson, Siegel, and their associates (Hale, Miller, & Stevenson, 1968; Siegel, 1968; Siegel & Stevenson, 1966), using a discrimination learning procedure to investigate the learning of focal and incidental material by normal children of different age levels, have produced results that are in basic agreement with Hagen's findings. In addition, Siegel (1968) found significant negative correlations between the only achievement measures he used, word recognition and paragraph reading scores from the Gates Primary Advanced Reading Test, and incidental learning in eight-year-olds. These negative correlations suggested that young children who are poor readers may give too much attention to incidental stimuli at the expense of focusing on the more important central stimuli.

Research using Hagen's paradigm to study the development of selective attention has employed only visual tasks. Thus, little is known about the development of selective attention to auditory stimuli. However, using a dichotic listening task to study selective attention in normal children, Maccoby (1967) and Maccoby and Konrad (1966, 1967) found that children develop the ability to listen to relevant, as opposed to irrelevant, stimuli. However, they did not report the sudden increase in efficiency at about 12 years of age that Hagen and his associates reported for visual stimuli.

Hallahan, Kauffman, and Ball (1974) have pointed out the many procedural differences between the two lines of research.

Although Hallahan, et al. (1974) studied selective attention to stimuli presented auditorily to normal children, their procedure differed in a major way from Hagen's procedure. In Hagen's visual procedure the focal and incidental stimuli were presented simultaneously on the same card. In contrast, Hallahan et al. presented the auditory focal and auditory incidental stimuli temporally rather than simultaneously. Specifically, children were presented with successive pairs of words. The first word of the pair, the focal stimulus, represented one conceptual category (e.g. animal), and the second word represented another conceptual category (e.g. food). The children were instructed to recall the first word of the pair but were later tested on the recall of both words. Although Hallahan, et al. did not use a visual procedure for comparison, they discussed their results in relation to Hagen's findings. Like Hagen, they found an age effect on focal recall; but unlike Hagen, they also found an age effect on incidental recall, with the older children being superior on the recall of both types of stimuli. In addition to analyzing focal and incidental recall separately, they used a single score, the selective attention index, to reflect the relationship between focal recall and incidental recall for each individual. An analysis of these scores, which represented the proportion of focal stimuli recalled minus the proportion of incidental stimuli recalled for each child, appears to be more relevant to the problem than separate analyses of focal and incidental scores, since separate analyses give no consideration to the relationship between these scores for each child. On this index Hallahan, et al. (1974) found a significant age effect, which was in line with Hagen's results.

However, Goodnow's (1971) finding that temporally-presented stimuli, either auditory or visual, were more difficult than spatially-presented stimuli would indicate that the two procedures were not of comparable difficulty. Therefore, since mode of stimulus presentation and task difficulty were confounded, no direct comparisons of the development of selective attention to visual and auditory stimuli can be made.

Another line of research suggests that attention to visually-presented and auditorily-presented stimuli develop differently in normal children. Several studies of learning and retention have shown that the auditory stimulus presentation mode is superior to the visual stimulus presentation mode for young children below approximately 11 years of age and that the visual stimulus presentation mode is superior to the auditory stimulus presentation mode for older children (Hartman, 1961; Perelle, 1972). Also, Perelle (1975), in a study in which he presented conflicting auditory and visual information simultaneously, found that children above 12 years of age paid more attention to visual information.

Some research on selective attention, using Hagen's paradigm, has been carried out with handicapped children. Hagen and Huntsman (1971) found no difference in selective attention between non-institutionalized retardates and normal children of equivalent mental ages. Neither did they find selective attention differences between a group of lower IQ (IQ = 55) and higher IQ (IQ = 78) retardates. They did find that institutionalized retardates were inferior to both normals and non-institutionalized retardates in selective attention performance.

Hallahan, Stainback, Ball, and Kauffman (1973), compared non-institutionalized educable retarded, spastic cerebral palsied children of two mental age levels

(mental ages approximately 7 years and 11 years) with normal controls. The cerebral palsied children were not deficient in selective attention when compared with normals of equivalent mental age. For both groups selective attention efficiency increased with an increase in mental age. The investigators concluded that mental age, rather than chronological age or IQ, determines selective attention performance.

Hallahan, Kauffman, and Ball (1973), comparing low and high achievers, found that the high achievers recalled more focal information but the groups did not differ on incidental information recalled. Thus, the high achievers were considered to be more efficient in selective attention.

Comparing learning disabled, mentally retarded, and normal children, equated on mental age, Mercer, Hallahan, and Ball (1977) found that differences on selective attention were not significant. However, differences were in the direction of favoring the normals over the mentally retarded. Mercer, et al. (1977) pointed out that the small number in each group (n = 15) may have mitigated against significant results.

The meager research comparing selective attention in handicapped and normal children as measured by focal and incidental recall has produced equivocal results. Differences have been found for institutionalized, but not non-institutionalized, mentally retarded children. With groups equated for mental age, differences between learning disabled and normal children were not found in one study, while in another study high and low achievers were found to differ on focal recall, but not on incidental recall.

A widely used procedure to diagnose deficits in learning disabled children, the Illinois Test of Psycholinguistic Abilities (ITPA), contains two subtests, Visual Sequential Memory and Auditory Sequential Memory,

which appear to tangentially involve selective attention. That is, the recall of visual and auditory stimuli presented sequentially would require attention to the stimuli, as well as memory for them. Both attention and memory are also required in recall of the focal stimuli in Hagen's paradigm. Although it is not known that these ITPA subtests and the Hagen procedures tap the same attentional and memory functions, Kirk and Paraskevopoulos (1969) found reading disability cases to perform poorly on these subtests.

According to Douglas (1976), problems with attention, impulse control, and hyperactivity occur together. She pointed out that these characteristics occurred in Clements' (1966) list of the 10 most frequently cited characteristics of children with learning disabilities. She hypothesized that problems with attention and impulse control permeate and impair the functioning not only of hyperactive children but also of children with a wide range of disabilities. Even though it has been observed that hyperactivity diminishes when children reach adolescence, impulsivity is observed to remain a serious problem (Weiss, Minde, Werry, Douglas, & Nemeth, 1971).

Kagan's (1965) Matching Familiar Figures Test (MFF) has become "the primary index" for the assessment of reflection-impulsivity in children. Kagan has conceptualized reflection-impulsivity in terms of decision time. He states that "the reflection-impulsivity dimension describes the child's consistent tendency to display slow or fast response times in problem situations with high response uncertainty" (Kagan, 1965, p. 134). A consequence of the tendency toward fast decision in uncertain situations is an increased likelihood of making errors, because errors cannot be caught before a response is overtly made (Kagan, 1965). Thus, in the measurement of reflection-impulsivity, the MFF yields two measures, a

latency score and an error score, with impulsive children having latency measures below the median and error measures above the median and reflective children having latency scores above the median and error scores below the median. The impulsive child is further characterized by Kagan and his colleagues as being restless, distractible, hyperactive, emotionally uncontrolled, risk taking, gregarious, hyperaggressive, and retaliative (Kagan, 1965; Kagan, 1966; Kagan, Rosman, Day, Albert, & Phillips, 1964; Kagan & Kogan, 1970). Further, the impulsive method of problem solving is characterized as

> "...likely to be associated with the execution of solution hypotheses that are incorrect. The impulsive child is apt to act upon his initial hunch with minimal reflection, carry through a false hypothesis mentally, and offer an answer without critical examination of its potential accuracy. The anxiety resulting from repeated failure, as a consequence of impulsive reporting, could lead to generalized expectations of failure and withdrawal of involvement from intellectual tasks" (Kagan, 1965, p. 13).

If Douglas' (1974) statement that impulsivity is a characteristic of learning disability is correct, learning disabled children would be expected to be designated as impulsive by Kagan's MFF measures. Also, on the basis of the observations of Weiss et al. (1971), older learning disabled children would be expected to be impulsive on the MFF measures, even though they are not hyperactive.

A few studies have used the MFF to study reflection-impulsivity in learning disabled children. Campbell, Douglas, and Morgenstern (1971)

found that children attending a clinic for problems of hyperactivity were significantly more impulsive than normal controls on both the latency and error measures of the MFF. Cohen, Weiss, and Minde (1972) found that a group of hyperactive adolescents were also more impulsive than normal controls. Ollendick and Finch (1973), comparing brain damaged and normal children who differed on IQ and chronological age but not on mental age, found the brain damaged children to be significantly more impulsive on the MFF error and latency measures.

Hallahan, et al. (1973) found that low achievers were more impulsive than high achievers on the MFF error (accuracy) score but not on the MFF latency (time) score. This finding may well be a function of the relative validity of the MFF latency and error measures and not an indication that the difference in impulsivity between high and low achievers is equivocal. Evidence has recently been presented which supports the construct validity of the MFF error measure and raises questions about the validity of the MFF latency measure (Block, Block, & Harrington, 1974; Brown & Quay, 1977; Popkin, Quay, Weld, & McLeskey, 1977). Hallahan, et al. (1973) found no clear relationships between selective attention and reflection-impulsivity in high and low achievers.

The present study had several purposes. A major purpose was to compare the selective attention performance of 7-year-old and 12-year-old learning disabled and normal children to visual and auditory stimuli. In view of previous observations that learning disabled children have problems with attention (Clements, 1966; Douglas, 1974), normal children were expected to be superior to learning disabled children in selective attention performance to both visual and auditory stimuli at both age

levels. However, because selective attention is likely to follow the same developmental trend in learning disabled as in normal children, selective attention performance was expected to increase with age in learning disabled, as well as in normal, children. On the basis of previous research findings concerning children's preferences for visual and auditory stimuli (Perelle, 1972), the younger normal children were expected to be superior in selective attention to auditory as compared to visual stimuli, and the older normal children were expected to be superior in selective attention to visual stimuli. However, because learning disabled children may have perceptual difficulties in the visual modality, the auditory modality, or both modalities, predictions of differential performance to visual and auditory stimuli for either the younger or older learning disabled group could not be made.

Another purpose was to compare 7-year-old and 12-year-old normal and learning disabled children on reflection-impulsivity and to relate reflection-impulsivity to selective attention for both age groups.

A third purpose is to study the relationship between the ITPA subtests, Visual Sequential Memory and Auditory Sequential Memory, and selective attention to visually-presented and auditorily-presented stimuli in learning disabled children. A correlation between these measures for learning disabled children would provide some construct validity for these ITPA subtests as measures of attention to and memory for auditory and visual stimuli.

The specific hypotheses are: (1) Seven-year-old and 12-year-old normal children are superior to learning disabled children in selective attention to both visual and auditory stimuli. (2) Selective attention

increases with age for both normal and learning disabled children for both visually presented and auditorily presented stimuli. (3) Comparing selective attention to visually presented and auditorily presented stimuli, the younger group of normal children are superior in selective attention to auditorily presented stimuli, while the older normal children are superior in selective attention to visually presented stimuli. (4) For both age groups of learning disabled children, no difference will occur in selective attention to visually presented and auditorily presented stimuli. (5) Both 7-year-old and 12-year-old learning disabled children will be more impulsive on Kagen's MFF latency and error measures than normal children of equivalent age levels. (6) Reflection-impulsivity measures are correlated with selective attention efficiency for both learning disabled and normal children. (7) For learning disabled children, the Visual Sequential Memory subtest of the ITPA is correlated with selective attention efficiency to visually presented stimuli and the Auditory Sequential Memory subtest of the ITPA is correlated with selective attention efficiency to auditorily presented stimuli.

Method

Subjects

Sixty learning disabled and sixty normal children, thirty from each of two age groups, were randomly selected and assigned either to the auditory or the visual method of stimuli presentation. The mean age of the older group was twelve years, four months. The mean age of the younger group was seven years, ten months. The learning disabled children were selected from classes for specific learning disabilities in a large suburban Atlanta county school system (Dekalb)

County). They were placed into the classes after a rigorous diagnostic examination by qualified psychologists and a history of difficulty in coping with the regular school program. No child with obvious physical defects nor diagnosed brain damage was included in the sample. The normal sample was selected from a representative school in the same county school system. To obtain a sample of learning disabled children of sufficient size, the learning disabled children were selected from eight schools, comparable to and including the one from which the normal sample was obtained, in the same county school system. All schools served a predominately middle-class population. All children had normal intelligence.

Procedures

The results of a pilot study to test the appropriateness of the stimuli and instructions indicated that 100% of the second-grade children in the pilot sample named all the stimuli and understood the task requirements, including the concept of order of presentation.

Each child was tested individually in either the auditory or the visual mode of stimulus presentation. In each condition the children were given a practice task consisting of a set of six stimuli. In the visual condition the stimuli were pictures of toys presented by means of a slide projector, and in the auditory condition the stimuli were names of the same toys, presented by means of a tape recorder. The children were instructed to attend to all six of the stimuli so that they could later name them in the order of their presentation.

Visual Stimulus Presentation Mode

In the visual stimulus presentation condition, all stimuli were

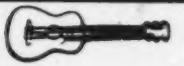
presented by means of a carousel slide projector, set at an automatic exposure time of five seconds with a time interval between slides automatically controlled at approximately two seconds. The slide projector was placed at a distance of five feet from the screen. The child was seated just behind and to one side of the projector. Each slide contained a large picture of an animal (focal stimulus) which measured approximately 45 x 45 centimeters and a smaller picture of a sound-making object (the incidental stimulus) which measured approximately 5 x 6 centimeters when projected on the screen. The focal and incidental stimuli, in order of presentation, were: lion--whistle, cat--fire engine, horse--guitar, cow--train, dog--telephone, pig--car. Illustrations of the pictures are presented in Figure 1, which appears on the next page.

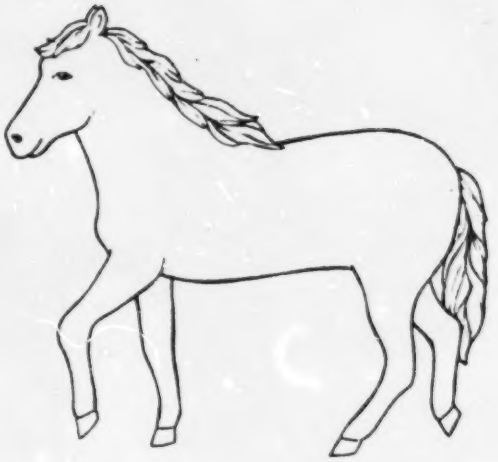
Immediately following the practice session the children were given the following instructions:

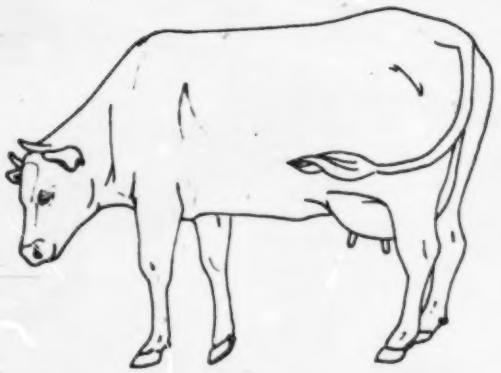
> Now you are going to see six pictures of animals. After you see all six pictures, I will ask you to tell which was first, second, third, fourth, fifth, and sixth. You will have to name the animals in order.

To measure focal memory, after the presentation of the set of slides, the children were asked to recall the names of the animals in order of presentation. The measure of focal memory was the number of animal pictures recalled in the correct position.

To obtain a measure of incidental memory, the children were then asked to recall the little pictures that appeared on the same slide with the animal pictures. The measure of incidental memory was the number of incidental stimuli recalled.







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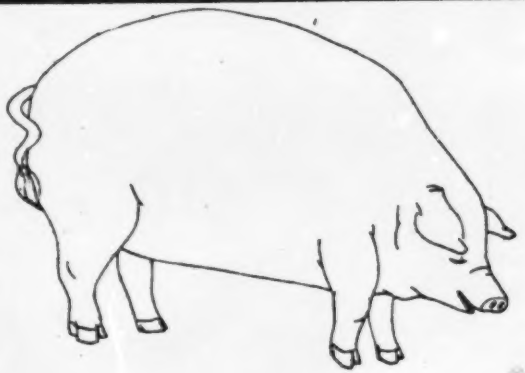

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FIGURE 1

The Auditory Stimulus Presentation Mode

In the auditory stimulus presentation condition, the stimuli were presented by means of a tape recorder. Each stimulus was five seconds in duration, with approximately two seconds between stimuli. The recordings were professionally made, with decibel levels controlled. A female communications professional, using standard pronunication, recorded the words.

The focal stimuli were the animal names, and the incidental stimuli were the sounds made by the objects pictured in the visual presentation. At the same time that the animal name was being spoken, a sound was made in the background. The mean difference in volume between the animal name and background sound was 15 decibels. The stimuli were the same as those in the visual condition and were presented in the same order. For example, when the word lion was spoken, a whistle was blown in the background; paired with cat was a fire engine siren; with horse, a guitar being played; with cow, the sound of a train; with dog, a telephone ringing; and with pig, a car horn sounding.

Immediately following the practice session the children were given the following instructions:

> Now you are going to hear the names of six animals. After you hear all six names, I will ask you to tell me which animal was named first, second, third, fourth, fifth, and sixth. You will have to name the animals in order.

To measure focal memory, after the presentation of the six sets of sounds, the children were asked to recall the names of the animals in the order of presentation. The measure of focal memory was the number of animal words recalled in the correct position.

To measure incidental memory, the children were then asked to recall the other sounds they heard at the same time they heard the names of the animals. The measure of incidental memory was the number of incidental sounds recalled.

All children were administered Kagan's MFF test of reflection-impulsivity. Latency scores (the time required to make the first response to each of the 12 tasks) and error scores (the total number of errors made on the 12 tasks) were obtained for each child.

The learning disabled children were administered two additional tasks: The ITPA Visual Sequential Memory Test and the ITPA Auditory Sequential Memory Test.

Results

Tables 1, 2, and 3 on the following pages present the means and standard deviations for the focal recall scores, incidental recall scores, and selective attention index, respectively, for learning disabled and normal children in each of the stimulus conditions at both age levels.

A 2(type of child) x 2(age) x 2(stimulus condition) multivariate analysis of variance was carried out, with focal recall and incidental recall scores as the dependent variables. This analysis indicated that a difference occurred between age groups, $\underline{F}\,(2, 112) = 5.64$, $p < .01$. No difference occurred between learning disabled and normal children nor between the auditory and visual stimulus conditions. Separate univariate analyses of variance on focal and incidental scores indicated that the age difference was significant for focal recall scores, $\underline{F}\,(1, 116) = 10.99$, $p < .001$, but not for incidental recall scores.

Table 1

Means and Standard Deviations for Visual and Auditory Focal Recall Scores of Seven- and Twelve-Year Old Learning Disabled and Normal Children

	Presentation Mode			
Group	Visual		Auditory	
Learning Disabled	$\bar{x}$	SD	$\bar{x}$	SD
7-year-olds	2.86	1.50	2.53	1.88
12-year-olds	3.06	1.66	3.93	1.58
Normal				
7-year-olds	2.53	1.64	3.00	1.69
12-year-olds	3.87	1.50	4.07	1.79

Table 2

Means and Standard Deviations for Visual and Auditory Incidental Recall Scores of Seven- and Twelve-Year Old Learning Disabled and Normal Children

	Presentation Mode			
Group	Visual		Auditory	
Learning Disabled	$\bar{x}$	SD	$\bar{x}$	SD
7-year-olds	1.73	1.28	1.67	0.82
12-year-olds	2.06	0.96	2.20	1.21
Normal				
7-year-olds	2.73	1.22	1.87	0.64
12-year-olds	2.40	1.06	2.47	0.83

Table 3

Selective Attention Index for Visual and Auditory Presentations with Normal and Learning Disabled Seven- and Twelve-Year-Olds

Condition	Selective Attention Index			
	Normal		Learning Disabled	
	Mean	SD	Mean	SD
Visual				
7-year-olds	-.03	.24	.19	.27
12-year-olds	.24	.22	.17	.30
Auditory				
7-year-olds	.19	.26	.14	.45
12-year-olds	.27	.29	.29	.31

The Tukey Paired Comparisons Technique was used to further indicate where the age differences occurred on the focal memory scores. This analysis indicated that for normal children focal scores increased with age for both auditorily and visually presented stimuli ($p < .01$). No difference occurred at either age level in selective attention to visual and auditory stimuli. The 7-year-old learning disabled children attended equally well to auditory and visual stimuli. However, the 12-year-old learning disabled children were superior in selective attention to auditory, as compared to visual, stimuli. For learning disabled children focal memory scores increased with age for auditorily presented stimuli ($p < .01$), but not for visually presented stimuli.

While this analysis permitted comparisons on each of the two measures, focal and incidental recall, taken separately, it did not permit an analysis of individual performance on focal recall relative to incidental recall. For such an analysis, the selective attention index, described by Hallahan and his colleagues (Hallahan, Kauffman, & Ball, 1974; Hallahan, Stainback, Ball, & Kauffman, 1973) was calculated for each child. The selective attention index (proportion of focal stimuli recalled minus proportion of incidental stimuli recalled) were analyzed by means of a 2(type of child) x 2(age) x 2(stimulus condition) analysis of variance. This analysis yielded the same results as the analysis of focal recall scores. The main effect of age was significant, $F\left[1, 112\right] = 5.17$, $p < .05$, with the older children having higher selective attention index scores than the younger children. No differences occurred between the learning disabled and normal children nor between the auditory and visual stimulus presentation conditions. No significant interactions occurred.

The Tukey Paired Comparisons Technique was again used to ascertain where the age differences occurred. Although for normal children the selective attention index scores tended to increase with age in both conditions, the increase was significant only for the visual condition. For learning disabled children the selective attention index scores increased with age for the auditory condition, but not for the visual condition. In this analysis, as in the comparisons of focal recall scores, the older learning disabled children were shown to be equivalent to the younger learning disabled children in selective attention to visual stimuli. This finding suggests that in learning disabled children, the developmental trend of increased selective attention efficiency with age follows the same pattern that it does in normal children for auditory stimuli, but not for visual stimuli.

Table 4 on the following page presents the means and standard deviations of the MFF error and MFF latency scores for 7-year-old and 12-year-old learning disabled and normal children. To ascertain whether learning disabled and normal children at each of the age levels differed on reflection-impulsivity, the MFF error and MFF latency scores were analyzed by means of a 2(type of child) x 2(age) multivariate analysis of variance. The main effects of both type of child (learning disabled - normal), $F\left(1, 116\right) = 4.72$, $p < .05$, and age, $F\left(1, 116\right) = 15.07$, $p < .01$, were significant. Separate univariate analyses were then performed on MFF error and MFF latency scores. For MFF error scores, significant main effects were obtained for both type of child (learning disabled - normal), $F\left(1, 116\right) = 6.90$, $p < .01$, and age, $F\left(1, 116\right) = 20.34$, $p < .001$. The interaction was not significant. For MFF latency scores no significant differences occurred, and the interaction was not significant.

Table 4

Means and Standard Deviations of MFF Latency and Error Scores for Seven- and Twelve-Year Old Learning Disabled and Normal Children

	MFF			
Group	Latency		Error	
Learning Disabled	$\bar{X}$	SD	$\bar{X}$	SD
7-year-olds	115.50	61.09	16.53	6.46
12-year-olds	114.70	66.89	11.10	5.67
Normal				
7-year-olds	118.00	47.52	13.17	5.07
12-year-olds	109.73	45.98	9.33	4.88

The Tukey Paired Comparisons Technique was used to ascertain where the MFF error score differences occurred. For both learning disabled and normal children MFF error scores were significantly lower for the older children than they were for the younger children, indicating that the older children in both groups were less impulsive than the younger children. The MFF error scores were significantly higher for the 7-year-old learning disabled children than they were for the 7-year-old normal children, but the difference between the MFF error scores for the 12-year-old learning disabled and normal children was not significant.

To ascertain whether reflection-impulsivity was related to selective attention, correlations between the selective attention index scores calculated for each child and MFF error and MFF latency scores were carried out. Tables 5 and 6 on the following pages presents correlations between selective attention index scores and MFF latency and MFF error scores for learning disabled and normal children at both age levels. Of the 38 correlation coefficients, only one was significant, fewer than would be expected by chance. These findings indicated that selective attention to neither the visual nor the auditory stimuli was related to reflection-impulsivity as measured by the MFF test.

Table 7 on the following page presents the correlations between auditory selective attention index scores and the ITPA Auditory Sequential Memory Test and between visual selective attention index scores and the ITPA Visual Sequential Memory Test. The fact that none of the correlations was significant indicates that selective attention to stimuli presented to a particular modality (auditory or visual) is unrelated to the ITPA Sequential Memory tasks employing stimuli presented to the same modality.

Table 5

Correlation Coefficients between Selective Attention Index Scores and MFF Latency and Error Scores for Learning Disabled and Normal Children at Two Age Levels

	MFF			
Group	Latency		Error	
Seven-year-old	Auditory	Visual	Auditory	Visual
Learning disabled	.02	.01	.13	.21
Normal	.38	.16	.07	.06
Combined	.12		.16	
Twelve-year-olds				
Learning disabled	.16	.01	-.73*	-.03
Normal	.42	-.17	-.10	.38
Combined	.06		-.13	

*$p < .001$

Table 6

Correlation Coefficients between Selective Attention Index Scores and MFF Latency and Error Scores for the Combined Auditory and Visual Stimulus Conditions

	MFF	
Group	Latency	Error
Learning Disabled		
7-year-olds	.00	.17
12-year-olds	.02	-.30
Normal		
7-year-olds	-.30	.06
12-year-olds	.12	.13
LD and Normal		
7-year-olds	-.13	.16
12-year-olds	.06	.13
7- and 12-year olds	-.04	-.05

Table 7

Correlation Coefficients between Auditory Selective Attention Index Scores and ITPA Auditory Sequential Memory Scores and between ITPA Visual Selective Attention Index Scores and ITPA Visual Sequential Memory Scores for Learning Disabled Children at Two Age Levels

Learning Disabled	Auditory	Visual
7-year-olds	.01	-.05
12-year-olds	-.40[a]	-.42[b]

a $p < .067$

b $p < .061$

Discussion

This study supported the results of other studies in indicating that there is no difference between learning disabled and normal children on selective attention as measured by recall of focal and incidental stimuli. However, the results of this analysis of changes in selective attention with age indicates that learning disabled children, in contrast to normal children, do not become more attentive with age to visual stimuli, as both groups do with auditory stimuli. That is, both normal and learning disabled older children are more attentive to auditory focal stimuli than are their younger counterparts. However, while the older normal children were also more attentive than their younger counterparts to the visual focal stimuli, the older learning disabled children did not differ from their younger counterparts on attention to visual focal stimuli. One explanation for this finding, and it is only conjecture, is that the school makes increasing demands for attention to visual stimuli, as opposed to auditory stimuli, in its increasing requirement for silent reading, attention to visually-presented mathematics problems, library work, and "seatwork" as the child advances. Thus, as normal children progress, the tasks required by the school perhaps demand that they develop more efficiency of attention to visual stimuli than to auditory stimuli. On the other hand, the failure of learning disabled children to increase in attentional efficiency to visual stimuli with age may be related to their school failure. This failure to increase in attentional efficiency to visual stimuli with age may simply be due to a developmental lag in selective attention, which may underly school difficulties; or it may represent a negative reaction to visual stimuli because of their association with tasks,

such as reading, with which the child has had problems. Whether cause or result, these findings suggest that learning disabled children should be given special help in developing selective attention to visual stimuli. The findings also suggest that, for older learning disabled children, auditory presentation of instruction may be more effective in eliciting attention than visual presentation of instruction.

On Kagan's MFF Test of reflection-impulsivity, 7-year-old learning disabled children were shown to be more impulsive, by the MFF error measure but not by the MFF latency measure, than their normal counterparts. However, the difference between the 12-year-old normal and learning disabled children was not significant. This finding raises questions about the observation by Weiss, et al. (1971) that even though hyperactivity diminishes when hyperactive children reach adolescence, impulsivity remains a serious problem. The discrepancy between the present findings and the finding of Cohen, et al. (1972) that hyperactive adolescents were more impulsive on the MFF than normals may be explained by the fact that the adolescents in the Cohen, et al. (1972) study were hyperactive while the older children in the present study were learning disabled, but not necessarily hyperactive. The finding that the normal and learning disabled children differed on the MFF error but not on MFF latency is in basic agreement with the findings of several other studies comparing reflection-impulsivity in normals and handicapped groups. This finding supports the conclusion by Block, et al. (1974) that the construct validity of the MFF latency score is questionable, while the construct validity of the MFF error score has received empirical support.

The present finding of no clear relationship between selective attention and reflection-impulsivity as measured by the MFF is in agreement with the findings of Hallahan, et al. (1973).

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